Anchor University Journal of Science and Technology (AUJST)
A publication of the Faculty of Natural, Applied and Health Science, Anchor University Lagos
URL: fnas.aul.edu.ng
In AJOL: https://www.ajol.info/index.php/aujst
Vol. 4 No 1, September 2023, Pp. 1 - 7
ISSN: 2736-0059 (Print); 2736-0067 (Online)

SPATIOTEMPORAL PATTERNS OF MONKEY-POX TRANSMISSION IN NIGERIA: A SITUATION ANALYSIS FOR PUBLIC HEALTH MEASURES

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Submitted 28 March, 2023
Accepted 21 April, 2023
Competing Interests: The authors declare no competing interest.

ABSTRACT

Background: Out of the 277 cases of monkey-pox reported in Nigeria between January 1st and 14th of September 2022, 115 cases were in men, confirming the claim of WHO that the most recent epidemic is prevalent among males. **Objectives:** This study aim to comprehensively analyze the outbreak of monkey-pox in Nigeria, including its transmission dynamics, clinical characteristics, diagnostic methods, treatment options, vaccination efforts, and public health lessons, with the primary objective of providing insights into the epidemiology of the disease and recommending effective interventions for controlling its spread. **Results:** The hotspot analysis of monkey-pox in Nigeria showed that Katsina, Kano, Oyo, and Lagos are epidemic states with significant spatial autocorrelations of monkey-pox cases. Bubbles aggregated mainly in quadrants one, two and three in the Moran scatter plots proposed that the form of monkey-pox cases spatial distribution are the primary compositions which were in three distinct patterns, including low-low, low-high and high-high. A level 2 National Multi-sectoral Monkey-pox Emergency Centre (MPX-EOC) was recently activated by the Federal government of Nigeria to strengthen the surveillance system and coordinate present response activities to monkey-pox in Nigeria. Presently, there are no treatments and vaccines to monkey-pox in Nigeria and the Federal Government has urged Nigerians to adhere to safety proactive measures to reduce the widespread of the virus in the country. **Conclusion:** Therefore, in this report, we suggested prompt Public Health Intervention programs in all hotspot states for monkey-pox in the country with focus on crowded places such as markets and traditional gathering in order to reduce the potential transmission of the deadly virus, particularly among high-risk groups. Awareness all over the country about monkey-pox virus cannot be overemphasized.

Keywords: Monkey-pox, Public Health, Transmission, Nigeria.

INTRODUCTION

Outbreak of Monkey-pox in Nigeria

The current outbreak of monkey-pox was declared by the Director-General of World Health Organization (WHO) on the 23rd of July 2022 as Public Health Emergency of International Concern (PHEIC). As of 14th September 2022, more than 75,000 laboratory affirmed instances of monkey-pox have been accounted for in 82 non-endemic countries (CDC, 2022). A sum of 277 monkey-pox infections and four deaths were recorded so far in Nigeria between January 1st and September 14th, 2022. This reveals that 115 cases were in men, confirming the World Health Organization's (WHO) claim that the latest outbreak is widespread among men (Premium Times, 2022).

Between the year 1970 and 2017, a sum of 3 human cases of monkey-pox infection was reported in Nigeria, one in 1970 and two cases in 1978 (Breman *et al*., 1980). In September 2017, Nigeria experienced what could be regarded as a resurgence of the highest outbreak of the West African group of human monkey-pox, with 228 suspected cases out of which 60 cases were confirmed across 24states (Yinka *et al*., 2018). Later in that same year 2017, a cumulative of 88 cases of human monkey-pox were confirmed and reported in 15 states in Nigeria. Among these occurrences, River states accounted for the highest occurrence which was about 25 (28%) followed by Bayelsa 19 (22%) while 44 cases were reported by other 13 states. The most affected age range by the

https://dx.doi.org/10.4314/aujst.v4i1.1

by the monkey-pox were between 21 and 30 years 34(39%) (Ogoina et al., 2019),(WHO, n.d.).

In 2018, 49 confirmed cases of monkey-pox virus were reported in 13 states of which the same River state takes the highest burden 14 (29%) of cases followed by Bayelsa state 11 (21%), 11 other states shares the minor 24 cases. Individual in the age group between 31 and 40 years 17(35%) were the most affected. 47 cases of monkey-pox virus were reported in 2019 among 11 states where Lagos shares the largest burden 15(32%), Delta takes the second spot 10(21%), Rivers and Bayelsa state takes 7 (15%) cases each while 7 states shares the remaining 8 cases. The age range that were the most affected were 31-40 years. Furthermore, it was observed that the number of cases of monkey-pox were drastically reduced in 2020 where 8 cases were confirmed among 5 states in Nigeria with Lagos state taking the highest cases 4(50%) while the four states share the remaining 4 cases, individuals within the age range of 21-30 and 31-40 share 4(50%) cases and they were the most affected. In the year 2021, 34 cases were confirmed between 9 states in Nigeria of which Delta takes the highest burden 9(27%) of cases, Lagos and Bayelsa states have 6(18%) cases each while Rivers state and Edo state takes 5(15%) and 4(12%) respectively while four states assumed the remaining 4 cases. It was observed that the age group of 31-40 years takes the largest portion 13(38%) for most affected (Okoli *et al*., 2022) cases. 8 deaths across 20 states were recorded between 2017 to 2021 with age group 21-30 years with the highest risk of infection (NCDC, 2022).

The spatiotemporal distribution of Monkey-pox cases in Nigeria

A total of 277 cases were reported from January till 10th of September 2022 across Nigeria (Fig 1a). Global spatial autocorrelations in whole epidemic at sub-national level were examined by Moran's I (Fig. 1b). The hotspot analysis found that the epidemic situation showed obvious aggregation in four states (Katsina, Kano, Oyo, and Lagos), with significant spatial autocorrelations of monkey-pox cases. In all Moran scatter plots, bubbles mainly aggregated in the first, second and third quadrants, suggested that the spatial distribution form of monkey-pox cases were mainly composed of three main patterns: high–high, low–high and low–low. Moran's I was more than 0, and significance tests of Moran's I performed by Monte-Carlo method with 999-time simulations indicated significant (pseudo p value<0.05) global autocorrelation existed in the onset of outbreaks (Fig 1b).

Transmission and clinical characteristics of Monkey-pox virus

Monkey-pox can be transmitted to one another through intimate, personal, skin-to-skin contact such as direct contact with a monkey-pox rash, scab, or bodily fluids of a person with monkey-pox. Touching objects and surfaces used by an infectedperson with monkey-pox, contact with secretions of the respiratory organs, intimate contact including vaginal, oral and anal intercourse, or touching the genitals, hugging, massage, kissing and excessive face-to-face contact with an infected person are ways the virus can be transmitted. A person infected with monkey-pox can transmit it to people from the onset of symptoms until the rash completely healed and a new layer of fresh skin is formed. The illness usually lasts for 24 weeks while a pregnant woman if infected can transmit the virus through the placenta to her fetus (CDC, 2019; Lapa *et al*., 2022).

Clinical characteristics includes lesion which commonly arises in the genital and anorectal parts or in the mouth. Rash does not always spread to many parts of the body but might be restricted to only couple of injuries on palms and soles. Rectal symptoms such as bloody or purulent stools, rectal bleeding or rectal pain have been commonly reported during this current outbreak. Lesions are usually described as painful till they itch as they heal. Fever together with other prodromal symptoms including, chills, lymphadenopathy, malaise, myalgia, and headache may occur before the rash, after the rash, or may not be present at all, difficulty in breathing leading to sore throat, stuffy nose or cough may also occur. The incubation period is usually 3-17 days during which a person has no symptoms and can feel fine and the illness usually lasts 2 to 4 weeks. The severity of the disease can depend on the person's initial health and the route of exposure (CDC, 2022).

Known effects of monkey-pox can include encephalitis, pneumonia and eye infections,

https://dx.doi.org/10.4314/aujst.v4i1.1

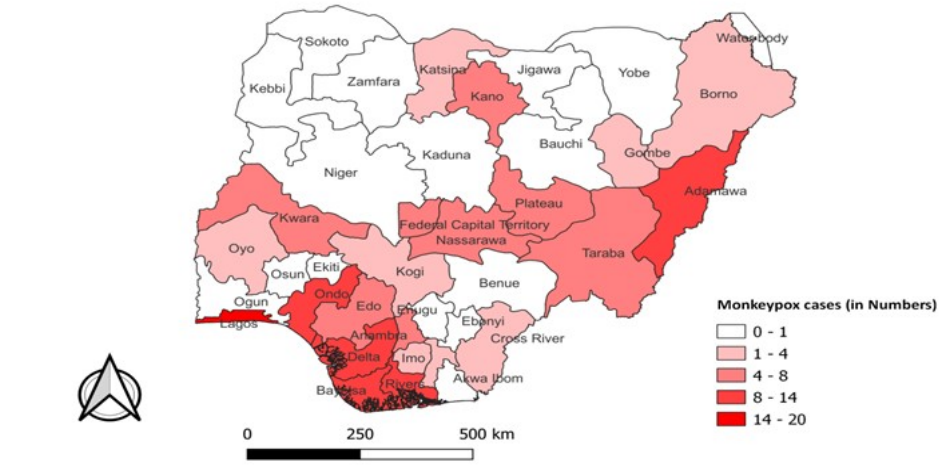

Fig 1. Choropleth map showing monkeypox outbreaks across Nigerian states (data till 10/9/2022)
The map was created using QGIS 3.22.11 'Biatowieza'
The base layer map was used from ArcGIS Hub.

Fig 1a: Chloropleth map showing monkey-pox outbreaks across Nigerian states (data till 10/09/2022)

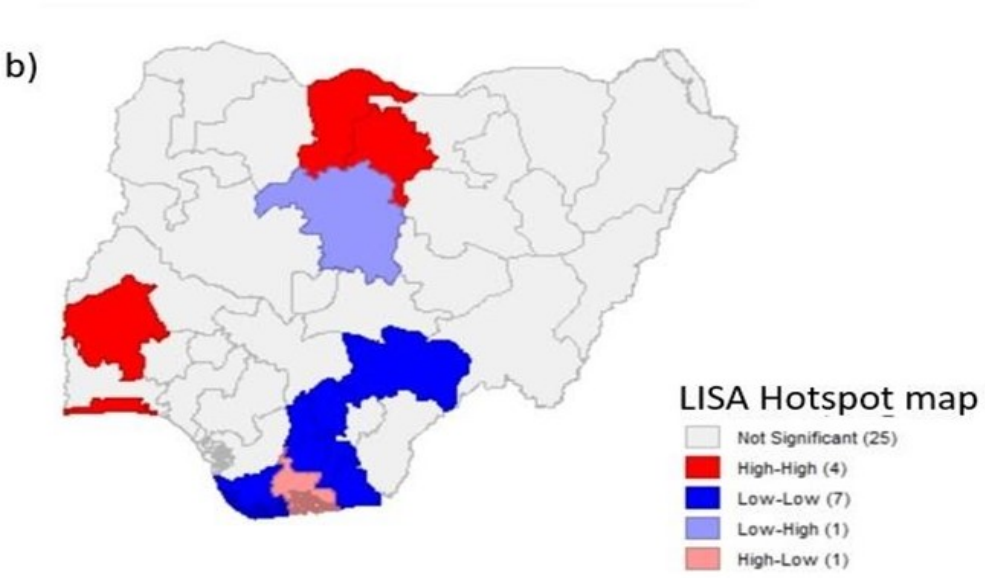

Fig 1b: LISA hotspot map showing onset monkey-pox cases with local spatial autocorrelation of Nigeria subnational level

https://dx.doi.org/10.4314/aujst.v4i1.1

which happen essentially among the younger ones less than 8 years of age and individuals with a weakened immune system or pregnant women. *Individuals infected with monkey-pox ought to stay isolated for the period of the sickness which usually takes 2 weeks to about a month* (Soucheray, 2022).

Laboratory Testing for Monkey-pox in Nigeria

Monkey-pox can be identified from a sample of fluid swabbed from the rash while other rash -causing diseases such as measles, chickenpox, syphilis, HIV and others are ruled out (Monkey -pox, John Hopkins 2022). Clinical features most times help in differentiating monkey-pox virus infection from other causes of vesiculopustular rash, also laboratory confirmation is necessary for a definitive diagnosis. Confirmatory diagnosis of monkey-pox in Nigeria requires nucleic acid amplification testing (NAAT) PCR using different targets in the viral genome to identify and distinguish from other poxviruses. Several diagnostic assays were well established in previous monkey-pox outbreaks. Real-time quantitative PCR (RT-qPCR) singly or in combination with sequencing has been recommended by the WHO (WHO, 2022; Punch, 2022).

The Federal government of Nigeria recently activated a level 2 National Multi-sectoral Monkey-pox Emergency Centre (MPX-EOC) and a genomic surveillance at NCDC's National Reference Laboratory in Abuja for strengthening the surveillance system and coordinate present response activities in Nigeria (NCDC, 2019). The major challenge to the federal Government intervention is that, this approach and resources is only available in a single state in the country. There is need for NCDC National Reference Laboratory to be installed in all states to enable easy capturing of all monkey-pox cases in the country (Oyewale, 2022).

Treatment

This *monkey-pox disease* usually heals on its own in two to three weeks, sometimes it takes a month. The Nigeria Centre for Disease Control as at 24th May 2022 said there are presently no specific treatments available for the monkey-pox infection in Nigeria, although various new antiviral agents such as brincindofocir and tecovirimate have in vitro and animal data supportive effects (Punch, 2022). Treatment for monkey-pox is suggested for individuals with immune-suppressed, pregnant or breastfeeding, atopic dermatitis in younger ones less than 8 years and those with one or several complications (Carlos *et al*., 2022). In addition to the treatment,WHO recommends patients suffering from monkey-pox to get enough fluids and foods to have optimum nutritional status. However, this drug treatment requires monitoring in the context of clinical research while being administered (CDC, 2022). Presently, there are no treatments to monkey-pox in Nigeria, the Federal Government warned and cautioned Nigerians, urging them to adhere to safety proactive measures to reduce the widespread of the virus in the country (Vanguard, 2022).

Vaccines

The Federal Government of Nigeria is working on collaborating with WHO and the United States Centre for Disease Control on how to access global stockpile of monkey-pox vaccination in order to put an end to the outbreak of the virus in the country (ThisDay, 2022). Delayed inception of vaccination rollout program campaign exercise, vaccine safety concerns, uncertainties, requirements and regulatory hurdles for storing vaccines, short shelf life of monkey-pox vaccine and the difficulty to access vulnerable communities as early as possible are some of the major concerns to the federal government implementing monkey-pox vaccines but efforts are ongoing to tackle the challenges (Ayenigbara *et al*., 2021). The Federal government in their latest statement released on September 14, 2022 by Dr Osagie Ehanire reports that Nigeria are working to partner with Serum Institute of India to begin local production of vaccines to be used in the country's vaccination program. Nigeria the most populous country in Africa imports all its vaccines to the country and they hope to start producing some in the country, transferring the skills and technology to their people alongside (Reuters, 2022).

There are presently no vaccines for monkey-pox virus in Nigeria as at June 22, 2022 and no African country have begun vaccination campaign for monkey-pox virus including Nigeria till date. USA, France and Germany are few of the countries that have begun the process (Bunmi, 2022). There are currently three smallpox vaccines officially licensed in the US Strategic National Stockpile (SNS) namely

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JYNNEOSTM (also known as IMVAMUNE, IMVANEX, MVA-BN) and ACAM2000®, the third is Aventis Pasteur Smallpox Vaccine (APSV) used to treat smallpox under an investigational new drug (IND) protocol (Hammarlund *et al*., 2005). Data from previous research suggest that early immunization with smallpox vaccine will have a protective effect against monkey-pox virus and bolster the clinical manifestations of the infection (Heymann *et al*., 1998).

Preventing Spread of the Infection

The spreading of monkey-pox can be prevented by avoiding close skin contact with people with rash that looks like monkey-pox, avoiding close contact with objects and materials used by a person with monkey-pox and washing of hands often will help prevent the spread of the infection. A confirmed monkey-pox patient ought to be promptly veiled, the sores ought to be covered with an outfit or sheet, and housed in disengagement inside a solitary room. Suitable utilization of individual defensive mechanism in medical services settings decreases the transmission risk. Medical care workers should put on gloves, outfit, eye mask, and a NIOSH-endorsed particulate respirator with channels of N95 or higher (Carlos *et al*., 2022; CDC, 2022). The governments have warned and seek all Nigerians to adhere strictly to safety measures to curb the spread as there is no specific treatment and vaccines to combat the viral outbreak, but Nigerians are stubborn and not yielding to instructions as ought to (Vanguard, 2022).

Public Health Lessons

The current monkey-pox episode shows why general wellbeing itself can't be overemphasized in Nigeria and throughout the world. Most of the available monkey-pox data currently comes from individual case or reports of outbreaks and from passive intermittent surveillance, none of which depicts an accurate overall picture. Clinical trials of treatments and vaccines have not been conducted despite being endemic in Africa for so many years. Monkey-pox testing capacities have improved drastically in Nigeria and other African countries but surveillance isn't what it's meant to be in Nigeria, contact tracing is not as recommended by WHO. There has been so much to learn lately after the global outbreak. Also, there is no approved treatment for monkey-pox in Nigeria and any other African countries presently though some antiviral drugs have been approved. For further prevention of the disease, education measures need to be implemented for people to take action against exposure to the virus. In addition, people should protect themselves well against animals that could harbor this zoonotic disease and be more careful when getting in contact with animals that have been restricted (CDC, 2022).

Conclusion

The hotspot analysis revealed that Katsina, Kano, Oyo and Lagos are the epidemic states in Nigeria with obvious aggregation and significant spatial autocorrelations of monkey-pox cases. Only Abuja has the capacity to conveniently diagnose monkey-pox virus in the country while there are no vaccines available yet. Therefore, Public Health Intervention programs such as social distancing and border measures, restriction of large gatherings, and mass awareness on monkey-pox virus in all hotspot states in the country with focus on crowded places like market and traditional gathering to help reduce the likely spread of the virus especially among the risk groups are suggested.

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Acknowledgment

We appreciate Global Health Focus and all authors for the timely and unusual supports in the form of supervision, expert advice and others